Hawaiian Monk Seal Population Monitoring and Habitat Mapping in the Northwestern Hawaiian Islands Using the APH-22 Hexacopter

Background

NOAA's Hawaiian Monk Seal Research Program, in collaboration with staff from SWFSC, AFSC, and NOAA AOC, has been exploring the use of unmanned aerial systems to study endangered monk seals and their habitats across the Hawaiian archipelago.

Methods

In 2015, the team tested the APH-22 Hexacopter at several locations in the Northwestern Hawaiian Islands to assess disturbance to wildlife (birds and seals) and the platforms utility in surveying monk seals and mapping habitat. The mapping project shown here occurred at Southeast Island, Pearl and Hermes Reef, approximately 2,090 km northwest of Honolulu.

Waypoint mapping missions were flown at 400 feet. Images were captured using a Canon EOS M mirrorless camera with a 22 mm lens. Observations of seal and bird response/interactions were recorded during each flight.

Preliminary Results and Discussion

Mapping surveys were successful with the ability to:

- detect seals and determine size
- map and identify vegetation type
- accurately map coastlines for erosion studies

Wildlife disturbances were minimal. Monk seals showed no response to APH-22 operations. Multiple species of bird showed a flushing response during take-off, most often when the hexacopter reached 40-60 feet altitude. Most birds settled within a minute after disturbance.

The island was mapped September 20, 2015 using a total of eight UAS flights averaging 12 minutes each. The shortest flight was 8 minutes, the maximum 13. The total time, including battery exchange, was just over two hours. A pre-flight waypoint grid was designed to provide 60 by 60 percent overlap between photographs and the hexacopter was programmed for autonomous flight. The camera was set to use shutter speed priority with an exposure of 1/2000 second and triggered at a five second interval. The 22 mm lens, a photograph resolution to 4608 x 3456 pixels, and a flight altitude of 120 meters (400 feet) resulted in a spacing of approximately 48 by 32 meters between waypoints for a grid count of 153. Each photograph covered an approximate area of 120 x 80 meters on the ground. Delays were set over each waypoint to populate the grid and selected photographs captured between waypoints were retained to enhance the overlap. A total of 182 images were processed using Pix4D Mapper software. The final image covers 0.27 sq km (65.9 acres) with a resolution of 2.5 cm per pixel. Subsequent to this survey, the APH-22 was enhanced to provide a camera trigger when the aircraft reaches a waypoint. Using this feature reduces the wait time at waypoints and, combined with increased flight speed between waypoints, will significantly reduce the flight time and number of flights required.

The full image is now online as a map service through NOAA's Digital Coast online portal. Visit the data registry https://coast.noaa.gov/dataregistry/ and type in a search for Southeast Island. The result can be viewed using online tools, imported into ArcMap as a service, or downloaded if you have a fast connection (file size 1.89 Gb). It is a *very* small portion of the national High-Resolution Orthoimagery dataset, you may have to do some navigating to find it.

Southeast Island in the Pearl and Hermes Atoll, Hawaii
Canon EOS M mounted on an APH-22 hexacopter (Mikrokopter avionics)
UAS planning and flight: Kathryn Sweeney NOAA, Don LeRoi of Aerial Imaging Solutions
Mission support: Charles Littnan NOAA, Jessica Lopez Bohlander NOAA, LT Michael Marino NOAA
Map compilation: Joel Stocker for AIS (October 2016)